

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
18 December 2003 (18.12.2003)

PCT

(10) International Publication Number  
WO 03/104765 A2

- (51) International Patent Classification<sup>7</sup>: G01N
- (21) International Application Number: PCT/US03/18164
- (22) International Filing Date: 10 June 2003 (10.06.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
60/387,325 10 June 2002 (10.06.2002) US
- (71) Applicant (*for all designated States except US*):  
TRUSTEES OF TUFTS COLLEGE [US/US]; Bal-  
lou Hall, Medford, MA 02155 (US).
- (72) Inventor; and
- (75) Inventor/Applicant (*for US only*): KOUNAVES, Samuel,  
P. [US/US]; 45 Sargent Road, Winchester, MA 01890 (US).
- (74) Agent: FARRELL, Kevin, M.; Pierce Atwood, Suite 350,  
One New Hampshire Avenue, Portsmouth, NH 03801 (US).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,  
SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN,  
YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**  
— *without international search report and to be republished  
upon receipt of that report*
- For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.*



WO 03/104765 A2

(54) Title: TOTAL ORGANIC CARBON (TOC) ANALYZER

(57) Abstract: The invention disclosed is a total organic carbon (TOC) analyzer comprised of an electrochemical cell comprising a diamond-film electrode doped with boron or other conductivity including material. The diamond-film electrode is the working electrode and carries out the oxidation of TOC to produce carbon dioxide. The apparatus further comprises sensors for detecting the carbon dioxide produced. Such sensors include but are not limited to a tunable diode laser and/or ion-selective electrode. The invention also discloses a method for measuring TOC in an aqueous solution using a total organic carbon analyzer.

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
18 December 2003 (18.12.2003)

PCT

(10) International Publication Number  
**WO 2003/104765 A3**

(51) International Patent Classification<sup>7</sup>: G01N 9/24, 11/00

(21) International Application Number:  
PCT/US2003/018164

(22) International Filing Date: 10 June 2003 (10.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/387,325 10 June 2002 (10.06.2002) US

(71) Applicant (for all designated States except US):  
TRUSTEES OF TUFTS COLLEGE [US/US]; Bal-  
lou Hall, Medford, MA 02155 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): KOUNAVES, Samuel,  
P. [US/US]; 45 Sargent Road, Winchester, MA 01890 (US).

(74) Agent: FARRELL, Kevin, M.; Pierce Atwood, Suite 350,  
One New Hampshire Avenue, Portsmouth, NH 03801 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,

CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,  
SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN,  
YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

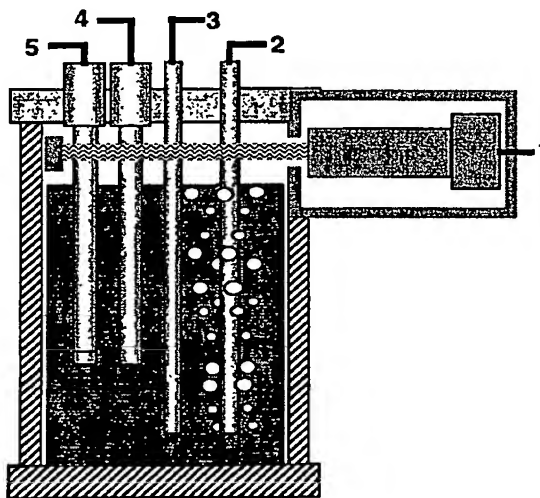
**Published:**

- with international search report
- before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments

(88) Date of publication of the international search report:  
19 August 2004

For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: TOTAL ORGANIC CARBON (TOC) ANALYZER



(57) Abstract: The invention disclosed is a total organic carbon (TOC) analyzer comprised of an electrochemical cell comprising a diamond-film electrode (2) doped with boron or other conductivity including material. The diamond-film electrode is the working electrode and carries out the oxidation of TOC to produce carbon dioxide. The apparatus further comprises sensors for detecting the carbon dioxide produced. Such sensors include but are not limited to a tunable diode laser (1) and/or ion-selective electrode (5). The invention also discloses a method for measuring TOC in an aqueous solution using a total organic carbon analyzer.

WO 2003/104765 A3

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/18164

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G01N 9/24; G01N/11/00

US CL : 73/614, 23.37, 53.04, 54.13, 54.14, 54.17

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 73/614, 23.37, 53.04, 54.13, 54.14, 54.17

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,808,178 A (ROUNBEHLER et al.) 15 September 1998, see entire document	1-13
A	US 6,541,272 A (MITRA) 01 April 2003 (01.04.2003), see entire document.	1-13
A	US 6,272,905 A (DRZEWIECKI) 14 August 2001, see entire document.	1-13
A	US 6,305,212 A (DRZEWIECKI) 23 October 2001 (23.10.2001), see entire document.	1-13
A	US 6,588,266 A (TUBEL et al.) 08 July 2003 (08.07.2003), see entire document.	1-13
A	US 4,977,785 A (WILLOUGHBY et al.) 18 December 1990 (18.12.1990), see entire document.	1-13
A	US 5,970,804 A (ROBBAT, Jr.) 26 October 1999 (26.10.1999), see entire document.	1-13



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

02 September 2003 (02.09.2003)

Date of mailing of the international search report

08 JUN 2004

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US

Commissioner for Patents

P.O. Box 1450

Alexandria, Virginia 22313-1450

Facsimile No. (703)305-3230

Authorized officer

Hezron Williams

Telephone No. (703) 308 0956